International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979, Impact Factor: RJIF 5.72
www.allsubjectjournal.com
Volume 4; Issue 3; March 2017; Page No. 64-70

Synergistic effect of vermicompost, vermiwash, bioaugmontation and Carrier based biofertilizer on growth of *Solanum melongena* L. var. Silligudi 111 (Brinjal)

[1] Nutan Kumari, [2] BS yadav, [3] Jyotsna K Peter

[1] M.Sc. (Ag), Dept. of Microbiology and Fermentation Technology, JSBB, SHIATS (AAI-DU), Allahabad, Uttar Pradesh, India
[2] M.Sc. (DT), WSFDF, SHIATS (AAI-DU), Allahabad, Uttar Pradesh, India
[3] Assistant Professor, JSBB, SHIATS (AAI-DU), Allahabad, Uttar Pradesh, India

Abstract
Vermicompost is a mesophilic biodegradation product where biofertilizer are commonly known as microbial inoculants that enhance plant growth. *Pseudomonas fluorescens* and *Azotobacter sp.* was characterized as a negative rod shaped bacteria showing positive biochemical test, *Pseudomonas fluorescens* and *Azotobacter sp.* was assayed for phosphate, zinc, potassium solubilization in different media. It produces IAA, Auxin, HCN and it showed PQQ independent activity. Phosphate solubilization index was higher in NBRIP (2.44±0.09) as compared to PVK medium (2.22±1.11). *Pseudomonas fluorescens* and *Azotobacter sp.* had a shelf life of 70 days. After harvesting the crop Physico-chemical analysis of soil shows that vermicompost and vermiwash had increases the N%, P%, K%, OC% and pH changed from 7.5 to 6.9. Vermicompost and Biofertilizer were amendments the soil. pH fluctuated among all treatments, T_6 (vermicompost + vermiwash + carrier based biofertilizer (*Pseudomonas fluorescens* and *Azotobacter sp.)* showed best growth of *Solanum melongena* for all growth parameters *viz* shoot length (138.2±2.03), root length (29.26±1.29), no. of branches (7.27±0.23), no. of leaves (71.33±0.30), leaf length (13.707±1.19), no. of flowers (13.6±0.2), no. of fruits (13±0.41), fruit diameter (16.59±1.55), fruit length (10.4±0.66). In conclusion, use of vermicompost, Vermiwash, *Pseudomonas fluorescens* and *Azotobacter sp.*as biofertilizer enhanced growth and yield of *Solanum melongena*.

Keywords: *pseudomonas fluorescens*, *azotobacter sp.* characterization, PGP activity, carrier based biofertilizer, vermicompost, vermiwash, *Solanum melongena*

Introduction
Brinjal (*Solanum melongena* L.) is a member of the Solanaceae family. Brinjal is one of the most popular and economically important vegetables. Aubergine is the British and also known as eggplant. Brinjal an erect annual plant, often spiny, with large, coarsely lobed fuzzy leaves, 10-20 cm long and 5-10 cm broad. The plants usually grow 45 to 60 cm high and bears long to oval shaped, purple or greenish fruits. Brinjal is a warm season crop and requires a long warm growing season but, it can be successfully grown as a rainy season and summer season crop and can be cultivated even at an elevation of 1200 m. It can be grown on all types of soils. In India, it is cultivated in about 5, 66, 000 hectares with a production of 9.596 metric tonne and productivity of 16.9 tha. [2]
Vermicompost, is a mesophilic biodegradation product resulting from interactions between earthworms and microorganisms in the breakdown of organic wastes. It contains plant hormones like Auxin and Gibberlins and enzymes which believed to stimulate plant growth and discourage plant pathogens. Vermicompost is proving to be highly nutritive 'organic fertilizer' and more powerful 'growth promoter' over the conventional composts and a 'protective' farm input increasing the physical, chemical and biological properties of soil, restoring & improving its natural fertility.**[11]**
Vermiwash is liquid fertilizer collected after the passage of water through a column of worm activation is very useful as a foliar spray. The vermiwash also contains enzymes and secretions of earthworms and would stimulate the growth and yield of crops [15]. Vermiwash was found to contain enzyme cocktail of proteases, amylases, urease and phosphatese. Microbiological study of vermiwash revealed that it contains nitrogen-fixing bacteria like *Azotobactre*r sp., *Agrobacterium* sp. and *Rhizobium* sp. and some phosphate solublizing bacteria [28].
Earthworm is a tube-shaped, segmented animal commonly found living in soil that feeds on live and dead organic matter. Earthworms perform many essential and beneficial functions in terrestrial ecosystems, including decomposition, nutrient mineralization, and soil structure improvement [9].
Biofertilizers are commonly known as microbial inoculants, are artificially multiplied cultures of certain soil organisms that can improve soil fertility and crop productivity. Biofertilizers play a very significant role in improving soil fertility by fixing atmospheric nitrogen, both, in association with plant roots and without it, solubilise insoluble soil phosphates and produces plant growth substances in the soil [26]. Beneficial microorganisms in biofertilizers accelerate and improve plant growth and protect plants from pests and diseases [10].

Materials and Methods
The isolate bacterium (*Pseudomonas fluorescens)* was procured from the Microbial Culture Collection Bank (MCCB), Department of Microbiology and Fermentation Technology, SHIATS, Allahabad. The characterization was done by cultural, morphological and biochemical analysis as per Bergey's Manual of Systematic Bacteriology [14]. *Pseudomonas aeruginosa* MCCB0039 was examined for

beneficial traits of PGPR *viz.*, solubilization of insoluble inorganic phosphate, Zinc, Potassium and production of plant growth promoting substances like IAA, HCN.

Isolation of *Azotobacter* from rhizosphere of Bamboo soil

One gram of soil sample was collected from rhizosphere of Bambusa bamboo soil and mixed in 9 ml sterilized ringer solution and a dilution was made up to 10^{-6}. Last (10^{-6}) was pour plates in NA and Jensen medium at 30°C for 24 to 48 h. The characterization was done by cultural, morphological and biochemical analysis as per Bergey's Manual of Systematic Bacteriology [14]. *Azotobacter sp.* examined for beneficial traits *viz.*, solubilization of insoluble inorganic phosphate, Zinc, Potassium and production of plant growth promoting substances like IAA, HCN.

Preparation of vermi compost

Vermicompost was prepared in circular plastic basket 60cm height filled with 5cm soil, 5cm dry leaves and 2000 ml cow dung slurry and covered with gunny bag. The soil dried leaves or cow dung was decomposed for 15 to 20 days thereafter *Eisenia fetida* earthworms (40 to 50) in number were released and a crack was developed. Water was sprinkled every third day to maintain adequate moisture and body temperature of earth-worms. The vermicompost was complited in the 2 months [24]. Physico chemical analysis of vermicompost involved estimation of the total nitrogen (%N), available phosphorus (%P), total potassium (%K) and organic carbon (%OC) of vermicompost was analysed at 15 days interval from 0 day to 60th day of maturation.

Preparation of Vermiwash

Vermiwash were set up in a plastic barrel of 20 liter capacity. A hole is drilled on one side and a vertical limb of a "T" joint tube is attached in a way that half of the tube projects inside the barrel. A tap is attached to the end of horizontal limb and the other end is closed with dummy net. The whole setup was mounted on a suitable pedestal keeping the tap open, a layer of broken bricks or pebbles are filled up to 25 to 30 cm inside the barrel. Water was made to flow through this layer followed by 20 – 30 cm layer of coarse sand or garden soil. This forms the base of filter unit. Over this 30 – 45 cm layer of good loamy soil is kept moistened. In this layer, *Eudrilus eugeniae* sp. of earthworms, cow dung and organic materials are placed on the top of this layer. This unit was moistened every day. After 60 days vermiwash starts forming in the container. Everyday about 3-4 lit of vermiwash was collected.

Microbiological analysis of vermicompost and vermiwash

One gram of vermicompost sample was collected and mixed in 10 ml of sterilized distiled water and dilutions were made up to 10^{-5}. Last dilution (10^{-5}) was spread on respective media plant at respective temperature and time as. PDA, NA, SCA, for enumeration of bacteria and fungi [25].

To check the purity of carrier material pH, moisture content, viable number count was tested for purity of carrier material. pH of carrier material was neutralized with the help of calcium carbonate (1: 10). Neutralized carrier material was sterilized in autoclave to dominated contaminate. 1 g of carrier material was spread on nutrient agar medium for checking any possible contamination (microbial growth).

Soil characteristics of the experimental site

The field used in this study was from a site situated in the SHIATS, University, Naini, Allahabad, in Uttar Pradesh. Before starting an experiment, composite of soil samples from the surface 0 to 20 cm depth were collected and analyzed for physical and chemical characteristics. The sandy soil has developed from field and is dark to very dark brown.

Evaluation of growth attributes of *Solanum melongena* SILIGUDI-111.

Germination test was conducted in three replications of five seeds. The temperature of 25 ± 30ºC and RH of 95 per cent was maintained during the germination test. The first and final germination counts were recorded on fifth days of germination test respectively for normal seedlings and germination was expressed in percentage. Mean height of the five plants selected randomly and tagged in the net plot was recorded for these plant in centimeter at different growth stages. The height was measured from the ground surface to the base of the fully opened leaf before heading and to the tip of ear head of the main shoot after heading. Numbers of green leaves present on the main shoot were counted for the five tagged plants in each replication at 24, 48, 72, 96 and 120 DAS. The average of five plants were taken and expressed as number of green leaves per plant. Root length were measured from collar region to the tip of the main root and expressed in centimeter for the five tagged plants in each replication at 120 DAS. The average of five plants were taken and expressed as root length (cm) per plant.

Statistical Analysis

The data recorded during course of investigation were analyzed statistically using sample standard deviation one way analysis of variance, Tukey' s HSD and Two way analysis of variance test at 5% significance level and interpretation was drawn accordingly [20, 21].

Results and Discussion

Cultural, morphological, biochemical and physiological characteristics of *Pseudomonas fluorescens* and *Azotobacter sp.*

The *Pseudomonas fluorescens* colony was Greyish colored on nutrient agar medium with Entire margin, Flat, Translucent, Oval in shape and characterized as Gram negative, rod shaped bacteria and showed negative reaction for MR-VP, Nitrate reduction, carbohydrate fermentation (Sucrose, Glucose, Lactose, D-Manitol, Trehalose, D-Galactose, D-Xylose, sorbital, L-Rhamanose, D- Fructose and L-Arbinose) and positive for (oxide, catalase, citrate utilization, Indole Production, urease, gelatin liquefaction, motility test, ONPG, PQQ test, starch hydrolysis).The *Pseudomonas fluorescens* showed confluent growth at low temperature *i.e* 10 °C while failed to grow at 50°C and 60°C. Growth of strain was subjected to grow at pH range of 5, 6, 7, 8, 9, 11 and 12. All pH supported the growth of strain. Salt tolerance was examined using NaCl concentration of 1, 2, 3, 4, 5% and it revealed that *Pseudomonas fluorescens was* able to tolerate all the NaCl concentration.

Pseudomonas fluorescens is a Gram-negative, motile aerobic rod that is widespread throughout nature and characterized by elevated metabolic versatility, Indole negative, Methyl red

positive, Oxidase positive [8], in a similar research characterized the species of *Pseudomonas fluorescens* as Indole negative Methyl red positive. Voges-Proskauer negative Cyanide producing, Gram-negative non endospore-forming rods with size range 1-0-3-0x0.5-0.7mm. Able to grow aerobically within 48h at 25 °C on yeast extract +peptone media. Able to grow in complex nutrient media. **[19]**

The *Azotobacter sp*. colony was Transparent colored on Jensen's Medium with Entire margin, Convex, Tranparent, Circular in shape and characterized as Gram negative, rod shaped bacteria and showed negative reaction for MR-VP, Nitrate reduction, Oxidase, citrate utilization, carbohydrate fermentation (Sucrose, Lactose, D-Manitol, Trehalose, D-Galactose, D-Xylose, sorbital, L-Rhamanose, D- Fructose and L-Arbinose) and positive for (catalase, Indole Production, urease, gelatin liquefaction, motility test, ONPG, PQQ test, starch hydrolysis).The *Azotobacter sp.* showed confluent growth at low temperature *i.e* 10°C while failed to grow at 50°C and 60°C. Growth of strain was subjected to grow at pH range of 5, 6, 7, 8, 9, 11 and 12. All pH supported the growth of strain. Salt tolerance was examined using NaCl concentration of 1, 2, 3, 4, 5% and it revealed that *Azotobacter sp*. was able to tolerate all the NaCl concentration.

Azotobacter spp. is a gram negative, flat, soft, milky, mucoid, gummy, motile, MR-positive, VP- negative, citrate positive, ureases positive, starch positive and indole positive [13]. Isolates was showed positive results to MR, Citrate, Urease, Oxidase, Catalase and Nitrate where they expressed negative result to Indole and VP. The isolates were efficient in hydrolyzing Starch.

Characterization of *Pseudomonas fluorescens* and *Azotobacter sp.* as a plant growth promoting rhizobacteria

Pseudomonas fluorescens and *Azotobacter sp.* was screened for plant growth promoting features which were assayed through phosphate solubilization, potassium solubilization, zinc solubilization, IAA and HCN production, PQQ independent activity. The strain showed a positive assay for the afore mentioned PGPR traits therefore, the strain was selected for biofertilizer production and examination.

A large number of bacteria including species of *Pseudomonas, Azospirillum, Azotobacter, Klebsiella, Enterobacter, Alcaligenes, Arthrobacter, Burkholderia, Bacillus, Rhizobium and Serratia* have reported to enhance plant growth *i.e*. phosphate solublization, IAA production, ammonia production, ACC deaminase activity, HCN production and catalase ar Isolated. 55 *Pseudomonas aeruginosa*, 22 *Pseudomonas putida*, 26 *Pseudomonas cepacia* and 37 *Pseudomonas fluorescens* strains were screened for their plant growth promoting activity *i.e*. indole acetic acid (IAA), hydrogen cyanide (HCN), siderophore production and P-solubilization. The study showed that *Pseudomonas* is an effective plant growth promoting bacterium [17].

Physico chemical analysis of mature vermicompost and vermiwash

Matured vermicompost was obtained at 60 days of incubation. It was dark brown in color odorless, tea granular in size and light weighted having pH 6.9. pH of vermicompost and vermiwash showed variation at 0 to 60 days. Various phases of vermicompost and vermiwash during of preparation pH was descending order with respect to times from 0 to 60 days, which was 7.5 at 0 days, 6.5 at 15 days, 7.5 at 30d, 7 at 45d, 6.9 at 60d, vermicompost had contains as in present study that is Carbon-2.45% at 0d, 3.10% at 15d, 3.25% at 30d, 3.85% at 45d, 4.10% at 60d. Nitrogen-0.53% at 0d, 0.58% at 15d, 0.61% at 30d, 0.63% at 45d, 0.66% at 60d. Phosphorus-0.10% at 0d, 0.13% at 15d, 0.11% at 30d, 0.10% at 45d, 0.08% at 60d. Calcium-1.53% at 0d, 1.57% at 15d, 1.54% at 30d, 1.56% at 45d, 1.60% at 60d.

The initial pH of the test was 6.5 and it was 7 at the end of the treatment. The available phosphorus content was 84.71% in T_2 (control) increase from the initial day has 115.47% T_2 (experiment) increase in phosphorus content [6]. Initial physical properties of vermicompost manure applied soil during the black gram pot culture studies. Compost manure application lowers the pH which may be due to the accumulation of organic acids from microbial metabolism or from the production of fulvic and humic acids decomposition [1]. A 4% higher Mg content in the vermiwash compared to the vermicompost. However, their Ca content was 40% higher in the vermicompost than the vermiwash [3].

Microbiological analysis of vermicompost and vermiwash

Total bacterial count of vermiwash in nutrient agar medium increased as 45 $\times 10^6$ cfu/ml, 98$\times 10^6$ cfu/ml, 138$\times 10^6$ cfu/ml at 0d, 15d and 30 days and gradually decreased as 125 $\times 10^6$ cfu/ml and 130$\times 10^6$ cfu/ml at 45d and 60 days. Yeast and mould count of vermiwash observed on PDA after 3-4 days the 10^6 cfu/ml as 12, 15, 20, 14 and 18 from 0 to 60 days respectively. Thermophilic count on Nutrient agar after 24 h was 0 at 0 day while it was 12$\times 10^6$ cfu/ml, 8$\times 10^6$ cfu/ml, 6$\times 10^6$ cfu/ml and 5$\times 10^6$ cfu/ml at 15,30,45 and 60 days.

Total bacterial count of vermicompost in nutrient agar medium increased as 40 $\times 10^6$ cfu/ml, 87$\times 10^6$ cfu/ml, 145$\times 10^6$ cfu/ml at 0d, 15d and 30 days and gradually decreased as 125$\times 10^6$ cfu/ml and 135$\times 10^6$ cfu/ml at 45d and 60 days. Yeast and mould count of vermicompost observed on PDA after 3-4 days the 10^6 cfu/ml as 10, 16, 20, 12 and 16 from 0 to 60 days respectively. Thermophilic count on Nutrient agar after 24 h was 0 at 0 day while it was 7$\times 10^6$ cfu/ml, 6$\times 10^6$ cfu/ml, 5$\times 10^6$ cfu/ml and 3$\times 10^6$ cfu/ml at 15,30,45 and 60 days.

The cfu count was higher at initial stages while it was getting decreased further due to the digestion of organic material the vermicompost formed. The vermicompost showed fourteen different fungal species belonging to the genera *Aspergillus, Fusarium, Mucor, Penicillium, Rhizopus* etc. In the present investigation there is a co-relation between the total fungal population in compost and vermicompost produced from tendu leaf litter generated from beedi industry, worked by the earthworm species, *Eudrilus eugeniae*. It showed significant increase in potato dextrose Agar media after 90 days of experimentation. The enhancement of fungal population might be due to increased nitrogen content in the vermicast which might have provided a good substrate for the growth of these microorganisms. This kind of increased microbial population has been reported by many workers [7, 16, 18].

Physico chemical analysis of soil before sowing

Physico-chemical analysis of soil was done before showing of plants which had different conditions such as %N-0.034, %P-0.630, %K-0.069, Organic-matter-0.050 and pH 7.5. Soil pH of samples ranged from 7.9 to 8.4, available nitrogen was in

lower range 135 to 160 Kg/ha, electrical conductivity values varied from 0.22 to 0.30 dS/m, available phosphorus content ranged from 8.0 to 10.1 Kg/ha, available potassium ranged from 295 to 355 Kg/ha which was in high range [22]. The plants absorb most of the nutrients within the pH range of 6.5 to 7.5 of soil [27].

Evaluation of growth attributes of *Solanum melongena* SILIGUDI-111

Variation in seed germination at 0-5 DAS was observed among 6 treatments over control. T_6 and T_5, was found seed germination while least non-significant was T_1 T_2, T_3, and T_4 over control. At 4 DAS T_6 T_5 and T_3 showed the maximum seed germination /5plants followed by T_2, T_1, T_4 one control. Study conducetd by agreement with present research who reported that Application of *Pseudomonas sp.* to maximum germination (92%) in cowpea plants to overall control [5]. Variation in shoot length at 24 DAS was observed among 6 treatments over control. T_6 (vermicompost + vermiwash+carrier based biofertilizer (*Pseudomonas fluorescens* and *Azotobacter sp.)* and T_5(vermicompost + *Azotobacter sp.* (liquid based biofertilizer) + *Pseudomonas fluorescens* (carrier based biofertilizer) was found most effective with higest shoot length *i.e* 138.2±2.03, 130.8±1.92 followed by T_6, T_5, T_2 while least significant was T_1, T_2, T_3 and T_4 over control. The significant was show in 24 DAS, 48 DAS (23.98±1.19), 72 DAS (47.09±3.27), 96 DAS (75.24±3.16) 120 DAS (138.2±2.03). Variation in root length cm were observed at the harvest time that 120 DAS (29.26±1.29) there T_6 (Vermiwash+Vermicompost +carrier based biofertilizer (*P. fluorescens* MCCB0039 and *Azotobacter sp.)* was most effective treatments over all 6th treatments as compared to control. Significantly were found at the harvesting time 120 DAS. Addition of compost or vermicompost to the potting media of tomatoes produced significant increases in the root biomass of the plants [27]. All isolates significantly increased root length and dry matter production of root of seedlings. Variation in leaf length at 20 DAS was observed among 6 treatments over control. T_6 (Vermiwash+Vermicompost +carrier based biofertilizer (*P.fluorescens* and *Azotobacter sp.)* was found most effective with higest leaf length *i.e.* 13.707±1.19 followed by T_5, T_3 and T_4 while least significant was T_1 and T_2 over control. The significant was show in 24 DAS, 48 DAS, 72 DAS (7.98±0.98), 96 DAS (8.41±0.18) and 120 DAS (13.707±1.19). It is reported that leaf length (cm)/plant increased by application of *Pseudomonas sp.* in *Rauwilfia serpentine* over control which is in agreement with present investigation.**[23]** Variation in number of fruit were observed at 72, 96 and 120 DAS. T_6 (Vermiwash+Vermicompost +carrier based biofertilizer (*P. fluorescens* MCCB0039 and *Azotobacter sp.)* was most effective for flowing at 72 DAS (2.93±0.5) over control. But at 72 DAS there was significant variation in flowing among the ten treatments as compared to control. Significant differences were found at harvest time *ie.*120 DAS that revealed T_6 as most effective tretments over control. The application of vermicompost increased significantly (P-0.05) number of fruits and total fruit yield per plant in compared to the control [4]. In a similar research conducted that the cow manure the treatment of 14 t/h vermicompost showed significantly higher number of cucumber per plant compared with other treatments [12].

Table 1: Variation in shoot and root length of *Solanum melongena* Var: SILIGUDI-111 at different time interval

Abre	Treatments	Shoot length (cm)					Root length
		24 DAS	48 DAS	72 DAS	96 DAS	120 DAS	120 DAS
T1	Vermicompost	5.3±0.2 b	11.95±4.26 bc	25.94±1.92 cd	43.25±2.48 bc	51.44±17.41c	24.2±0.60bc
T2	Vermiwash	4.7±0.34bc	12.17±5.80 bc	24.55±5.39 bc	50.69±6.64bc	65.01±12.22 c	24.9±0.73 bc
T3	Vermicompost +Vermiwash	4.75±0.58 bc	10.53±2.98	22.98±1.44 bc	47.89±7.53 bc	65.92±17.08 c	29.1±0.61 ab
T4	Vermicompost +*Azotobacter sp*, (Carrier)	5±0.32 b	12.53±1.03 bc	28.32±6.99 bc	65.51±5.33 ab	112.8±8.29 b	25.6±1.47bc
T5	Vermicompost +*P.f* (Carrier	4.8±0.71 ab	19.79± 1.28 ab	35.83±7.00 b	63.83±13.53 ab	130±2.09 ab	26.5±1.99 bc
T6	Vermicompost + vermiwash+ carrier	6.95±0.3 a	23.98±1.19 a	47.09±3.27 a	75.24±3.16 a	138.2±2.03 a	29.26±1.29 a
T0	Control	4.5±0.34 c	9.64±1.93 c	21.01±0.73 e	25.93±3.00d	40.41±12.47 d	21.8±0.78 d
$F_{cal.}$		8.65	8.87	17.93	16.29	31.49	13.74
$F_{tab.}$		2.08	2.08	2.08	2.08	2.08	2.08
F_{test}		S	S	S	S	S	S
CD-(0.05%)		0.33	13.43	19.45	69.45	226.94	1.53
S.Ed.(±)		0.16	6.46	9.53	33.39	109.1	0.75

Table 2: Vareation in leaf attributes of *Solanum melongena* Var: SILIGUDI-111 at different time interval.

Abre	Treatments		No. of leaves		Leaf length cm			Leaf Area Index
		24 DAS	72 DAS	120 DAS	24 DAS	72 DAS	120 DAS	120 DAS
T1	Vermicompost	6.4±1.1 d	23±0.52 cd	58.73±1.61 bc	1.40±0.12 bc	5.42±0.69 bc	9.02±0.32 c	22.76±0.19 b
T2	Vermiwash	7.067±0.75 bc	22.67±0.23 d	56.8±1.39 bc	1.97±0.35 bc	6.81±0.34 bc	9.8±0.31 bc	22.72±0.24 b
T3	Vermicompost +Vermiwash	6.57±0.23 cd	25.87±0.23 bc	57.53±0.92 bc	2.39±0.25 ab	7.98±0.98 ab	12.02±1.26 ab	22.92±0.65 b
T4	Vermicompost +*Azotobacter sp.* (Carrier)	7.27±0.11 ab	26.67±0.92 ab	59.53±2.19 bc	1.90±0.50bc	5.85±1.05 bc	9.37±0.80 c	22.34±1.16 b
T5	Vermicompost +*P.f* (Carrier)	7.13±0.50 ab	26.67±0.58 ab	58.93±1.85 bc	1.85±0.40 bc	7.30±0.50 b	10.17±0.73 bc	23.06±0.46 ab

T6	Vermicompost + vermiwash+ carrier	8.13±0.30 a	29.4±1.90 a	71.33±0.30 a	2.60±0.22 a	8.37±0.13 a	13.707±1.19 a	24.67±0.96 a
T0	Control	6.33±0.11 e	18.4±0 e	55.73±1.10 c	1±0.12 c	5.59±1.06 d	8.2±0.52 c	20.47±0.28 c
$F_{cal.}$		10.56	51.78	51.66	6.76	3.77	16.55	6.83
$F_{tab.}$		2.08	2.08	2.08	2.08	2.08	2.08	2.08
F_{test}		S	S	S	S	S	S	S
CD-(0.05%)		0.14	1.01	2.26	0.16	14.04	10.67	0.69
S.Ed.(±)		0.07	0.49	1.09	0.07	6.75	5.18	0.33

Table 3: Vareation in Root wt. Shoot wt and No. of flowers of *Solanum melongena* Var: SILIGUDI-111 at different time interval

Abre	Treatments	**Fresh Shoot & Root wt. of (g)**		**Dry Shoot & Root wt. of (g)**		**No. of flowers at (DAS)**			
		Fresh shoot	**Fresh root**	**Dry shoot**	**Dry root**	**48 DAS**	**72 DAS**	**96 DAS**	**120 DAS**
T1	Vermicompost	176.8±4.76 b	51.96±4.76 ab	176.8±4.76 bc	12.4±0.28 bc	0.67±0.12 c	2.40±0.35 bc	5.93±0.12bc	9.33±1.1cbc
T2	Vermiwash	166.6±2.29 bc	53.85±2.29 ab	166.6±2.29 bc	15.5±1.14 bc	1.39±0.58 b	2.60±0.35 ab	6.06±0.31ab	9.13±0.7bc
T3	Vermicompost +Vermiwash	197.1±4.83 ab	67±4.83 ab	197.1±4.83 ab	21.5±3.99 b	1.20±0.20 bc	2.60±0.2 ab	6.07±0.31 ab	9.06±0.31 bc
T4	Vermicompost +*Azotobacter sp.* (Carrier)	176.8±7.07 b	76.8±7.07 b	56.8±7.07 c	14.3±0.87 bc	1.4±0.36 ab	2.47±0.31bc	5.60±0.61bc	9.8±0.35bc
T5	Vermicompost +*P.f* (Carrier)	166.3±4.31 bc	56.7±4.31ab	166.3±4.31 bc	16.9±1.50 bc	1.20±0.20 bc	2.3±0.31bc	6.53±0.35ab	10.13±1.53 ab
T6	Vermicompost + vermiwash+ carrier	247.03±15.04 a	77.1±15.04 a	247.03±15.04 a	26±9.09 a	2.13±0.12 a	3.36±0.2 a	8.06±0.12 a	13.6±0.2a
T0	Control	110.27±0.50 c	40.9±0.50 c	110.27±0.50 d	10.7±0.67c	0.53±0.12d	1.4±0 c	4.39±0.53 d	7.2±0 d
$F_{cal.}$		7.35	3.51	8.90	5.83	6.00	5.54	9.41	16.36
$F_{tab.}$		2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08
F_{test}		S	S	S	S	S	S	S	S
CD-(0.05%)		574.09	75.43	5.86	8.62	0.18	0.24	0.58	0.99
S.Ed.(±)		276	36.26	2.82	17.92	0.09	0.12	0.28	0.48

Table 4: Variation in no., length, diameter, and weight of fruit of *Solanum melongena* Var: SILIGUDI-111 at different time interval.

Abbre.	**Treatments**	**No. of fruit (DAS)**			**Length of fruit cm (DAS)**		**diameter of fruit cm (DAS)**		**Fresh Fruit wt.(g) at 120 DAS**	
		72 DAS	**96 DAS**	**120 DAS**	**96 DAS**	**120 DAS**	**96 DAS**	**120 DAS**	**96 DAS**	**120 DAS**
T1	Vermicompost	1.8±0 b	5.87±0.11 bc	8.67±0.11 bc	7.98±1.28cd	8.21±1.41bc	11.48±2.80 cd	11.05±1.48 c	32.58±23.76 cd	66.02±17.52 cd
T2	Vermiwash	2.3±0 ab	5.8±0.34 bc	8.4±0 bc	9.13±1.30bc	8.56±1.12bc	13.43±1.91bc	11.86±0.40 c	44.84±19.72 bc	89.4±12.19 bc
T3	Vermicompost +Vermiwash	2.0±0.34ab	6.13±0.23 ab	8.73±0.11bc	8.32±0.88cd	9.20±0.35bc	12.5±1.41bc	12.71±0.25bbc	56.87±25.51 ab	89.67±8.71ab
T4	Vermicompost +*Azotobacter sp.* (Carrier)	2±0 ab	5.67±0.50 bc	8.93±0.80 bc	8.02±2.47cd	8.64±0.78bc	10.35±1.21bc	13.84±1.67bab	54.82±25.43 bc	82.43±24.65 bc
T5	Vermicompost +*P.f* (Carrier)	2±0 ab	5.6±0.34 bc	9.53±1.67b	6.57±1.94cd	8.47±0.40 b	11.57±3.58 bc	14.8±1.41 ab	56.86±25.51 ab	89.67±8.71ab
T6	Vermicompost + vermiwash+ carrier	2.93±0.5a	6.8±1.50 a	13±0.41a	15.26±9.48 a	10.4±0.66 a	15.74±0.80 a	16.59±1.55a	92.91±3.61 a	102.8±3.77 a
T0	Control	1.4±0 c	4.4±0.52 c	7.33± c	7.51±0.33d	8.80±1.41c	9.55±2.27d	10.24±0.21 d	24.87±5.05 d	30.35±4.09 d
$F_{cal.}$		6.13	3.83	22.57	3.01	4.03	2.65	10.76	5.77	8.59
$F_{tab.}$		2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08
F_{test}		S	S	S	S	S	S	S	S	S
CD-(0.05%)		0.20	0.60	0.58	32.83	20.57	6.64	1.89	520.4	296.9
S.Ed. (±)		0.10	0.29	0.28	9.89	9.89	3.19	0.91	250	142.7

Conclusion

Pseudomonas fluorescens and *Azotobacter sp.* was characterized as a Gram negative, rod shaped that possessed PGPR trait *viz* IAA and HCN production, Phosphate, Potassium and Zinc solubilization efficiency and PQQ independent activity. Physico- chemical analysis of vermicompost revealed qradual increase in contents (%) of N, P, K, and OC. Better growth of *Solanum melongena* under varius treatments revealed T_6 *ie.* Vermiwash+ Vermicompost +liquid based biofertilizer (*P.fluorescens* and *Azotobacter sp.)* After harvesting of plants Treatment wise physico-chemical analysis was done in different parameters *i.e.* N%, P%, K%, Organic matter and pH. In this analysis T_9 (Vermiwash+Vermicompost +carrier biofertilizer (*P.fluorescens* and *Azotobacter sp.)* was showed the best physico-chemical properties in compare to other treatments of soils as N% (0.40), P% (0.66), K% (0.069), OC% (0.050) and pH 7.5.

References

1. Albanell E, Plaixats J, Cabrero T. Chemical changes during vermicomposting (*Eisenia Andrei*) of sheep manure mixed with cotton industrial wastes. Journal of Biological Fertilizer of Soil. 1988; 6:266-269.
2. Anonymous. Package of Practices for vegetable crops. International Journal of Farm Sciences. 2006; 1(2):56-62.
3. Ansari AA, Kumar S. Effect of vermiwash and vermicompost on soil parameters and productivity of okra (*Abelmoschus esculentus*) in Guyana. African Journal of Agricultural Research. 2010; 5(14):1794-1798.
4. Azarmi R, Giglou TM, Hajieghrari B. The effect of sheep-manure vermicompost on quantitative and qualitative properties of cucumber (*Cucumis sativus* L.) grown in the greenhouse. African Journal of Biotechnology. 2009; 8(19):4953-4957.
5. Bhakthavatchalu S, Shivakumar S, Sullia SB. Characterization of multiple plant growth promotion traits of *Pseudomonas aeruginosa* FP6, a potential stress tolerant biocontrol agent. Annals of Biological Research. 2013; 4(2):214-223.
6. Bhat MR, Limaye SR. Nutrient status and plant growth promoting potential of prepared vermicompost. International Journal of Environmental Sciences. 2012; 3(1):312-321.
7. Chavan V, Joshi S, Pejaver M. Comparative Study of Microbial population in Vermicompost and Biocompost in Relation with Physicochemical Parameters. *National Conference on Biodiversity*. 2013; 1(6):978-81.
8. Deshwal VK, Singh SB, Chubey A, Kumar P. Isolation and characterization of *Pseudomonas* strains from potatoes rhizosphere at Dehradun valley, India. International Journal of Basic Applied Science. 2013; 2(2):53-55.
9. Edwards CA, Bohlen PJ, Linden DR, Subler S. Earthworms in agroecosystems. Earthworm Ecology and Biogeography in North America. Lewis Publisher, Boca Raton, FL. 1996, 185-213.
10. El-Yazeid AA, Abou-Aly HA, Mady MA, Moussa SAM. Enhancing growth, productivity and quality of squash plants using phosphate dissolving microorganisms (bio phosphor) combined with boron foliar spray. Research Journal of Agriculture and Biological Sciences. 2007; 3(4):274-286.
11. Gajalaksmi S, Aabbasi KA. Earthworms and Vermicomposting. *Indian* Journal of Biotechnology. 2004; 3:486-494.
12. Ghasem S, Morteza SA, Maryam T. Effect of organic fertilizers on cucumber (Cucumis sativus) yield. International Journal of Agriculture and Crop Sciences. 2014; 7(11):808-814.
13. Gomare KS, Mese M, Shetkar Y. Isolationof *Azotobacter* and cost effective production of biofertilizer. Indian Journal of Applied Research. 2013; 3(5):54-56.
14. Holt JG, Krieg NR. Gram Negative Aerobic Rods and Cocci. In: Bergey's Manual of Systematic Bacteriology, Williams and Wikins publishers, USA. 1984; 1:141-198.
15. Kale RD, Vinayaka K, Bagyaraj DJ. Suitability of neem cake as an additive in earthworm feed and its influence on the establishment of microflora. Journal of Soil Biology and Ecology. 1986; 6:98-103.
16. Karmegam N, Daniel T. Effect of biodigested slurry and vermicompost on the growth and yield of cowpea (*Vignaunguiculate* (L.), Journal of Environmental and Ecology. 1999; 18(2):367-370.
17. Kumar A, Kumar A, Devi S, Patil S, Payaland C, Negi S. Isolation, screening and characterization of bacteria from Rhizospheric soils for different plant growth promotion (PGP) activities: an *in vitro* study. Recent Research in Science and Technology. 2012; 4(1):01-05.
18. Marinissen JCY, Bok J. Earthworm amended soil structure, its influence on collembola population in grass lands. Journal of Soil Ecology Pedobiologia. 1988; 32(314):243-252.
19. Migula W. The Taxonomic status of the genus planococcus. International Journal of Systematic Bacteriology. 1894; 20(3):241-248.
20. Mittal SK, Sharma HV, Kumar A. Biophysics and Biostatistics. Unnati publication, modinagar, Inst. Ka r s ruhe: 2007, 235-238.
21. Panse VG, Sukhatme PV. Statistical methods for agricultural worker's. Indian council of Agricultural Research Publication, New delhi. 1967; 36:225-238.
22. Pujar KG, Hiremath SC, Pujar AS, Pujeri US, Yadawe MS. Analysis of physico-chemical and heavy metal concentration in soil of Bijapur taluka, Karnataka. Journal of Scientific Review and Chemical Communication. 2012; 2(1):76-79.
23. Reetha S, Bhuvaneswari G, Thamizhiniyan P, Mycin TR. Isolation of indole acetic acid (IAA) producing rhizobacteria of Pseudomonas fluorescens and Bacillus subtilis and enhance growth of onion (*Allim cepa*. L). International Journal of Current Microbiology and Applied Science. 2014; 3(2):568-574.
24. Sunitha ND, Giraddi RS, Kulkarni KA, Lingappa S. Evaluation methods of vermicomposting under open field conditions. Karnataka Journal of Agricultural Sciences. 10(4):987-990.
25. Trivedi RK, Goel PK. Chemical and Biological methods for water pollution studies. Indian Journal of Fundamental and Applied Life Sciences. 1986; 1(3):246-248.
26. Venkatashwarlu B. Role of bio-fertilizers in organic farming: Organic farming in rain fed agriculture: Central

institute for dry land agriculture, Hyderabad. 2008, 85-95.
27. Yadav B, Bajaj A, Saxena M, Paliwal G. Influence by physical properties of coal combustion residues (CCRs) on dry root productivity of Withania somnifera grown in black cotton soil. Journal of Pharmacognosy and Phytochemistry. 2013; 2(1):130-136.
28. Zambare VP, Padul MV, Yadav AA, Shete TB. Vermiwash Biochemical and Microbiological Approach as Ecofriendly Soil Conditioner. Journal of Agricultural and Biological Science. 2008; 3:1-5.